

SH40 中间砧苹果苗木休眠期假植 失水原因分析及防护措施

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摘 要:SH40 是目前我国华北地区主要应用的苹果矮化砧木。生产中冬季假植的 SH40 中间砧苹果苗木春季土壤解冻后往往出现中间砧段率先失水褶皱、随后整株失水现象, 对生产极为不利。该研究以一年生冬季休眠期红富士/SH40/八棱海棠为试材, 探究 SH40 中间砧苹果苗木休眠期假植中间砧段率先失水原因。结果表明:SH40 中间砧苗木休眠期假植中间砧段率先失水与中间砧自身的品种特性关系不大;根系蒸腾是导致中间砧段率先失水褶皱的主要原因, 当根系缺水, 蒸腾量较大时, 导管内部形成水势差, 迫使中间砧水分逆向运移至根部。根系越庞大, 中间砧段失水速率越快, 失水褶皱情况越严重。失水率达 20% 是中间砧及接穗能够复水成活的阈值, 超出阈值苗木即不能成活。

关键词:SH40 中间砧; 苹果苗木; 休眠假植; 失水

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矮化密植栽培是当今世界果树栽培发展趋势^[1], 而矮化砧木的利用仍是目前实现矮化密植栽培的重要手段^[2]。SH 系苹果矮化砧木因其易成花, 早果, 果实品质优良, 抗寒, 抗干旱, 抗抽条及适应范围广等优势在山西、河北、甘肃、陕西地区广泛使用^[3-6]。其中, SH40 是

目前我国华北地区主要应用的苹果矮化砧木^[7]。

研究表明 SH 系中间砧抗寒性及抗旱性优于 M7、M9^[8]、M26、GG80、JM7^[9] 中间砧, 越冬能力强。但生产中发现冬季休眠期假植的 SH40 中间砧苹果苗木春季土壤解冻后往往出现中间砧段率先开始失水褶皱, 随后整株失水现象, 轻则树势减弱, 重则树体死亡, 这给生产带来极为不利的影响。然而, 与之相关的研究却鲜见报道, 导致生产中缺乏理论指导, 防护措施显得极为盲目。

因此, 该研究以冬季休眠期 SH40 中间砧苹果苗木为试验材料, 探究 SH40 中间砧苗木休眠期假植失水原因, 旨在为生产中有效的防护措施提供参考依据。

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Abstract: To explore the genetic diversity of wild pear genus in Shanxi Province, the genetic diversity of 50 wild simples of *Pyrus* were analyzed using SSR molecular marker technique in this study, the genetic diversity of 50 wild pear genus were analyzed by SSR molecular marker technique. The results showed that, 236 alleles were amplified by 40 pairs of SSR primers and 5.90 alleles were amplified by per primers. The genetic diversity analysis showed that the genetic diversity indexes varied from 0.276 2 to 0.431 9, the expected heterozygosity were 0.335 0 to 0.775 0, and the polymorphism information content ranged from 0.236 8 to 0.431 2. The diversity of the 50 wild pear resources were showed high by the four parameters. The clustering analysis results showed that the similarity coefficient of the 50 cultivars ranged from 0.444 9 to 0.839 0, all the cultivars were divided into four groups at the similarity coefficient of 0.57, the cultivars of group I belonged to *Pyrus calleryana*, the cultivars of group II, III and IV belonged to *Pyrus betulaefolia*. The most cultivars of Baijia mountain and Jiang county belonged to the group II and group III, however, all the cultivars of Taigu county belonged to group IV, which accorded with the geographic distribution; we also found new *Pyrus betulaefolia* with big fruit and green skin.

Keywords: pear; wild resource; SSR; genetic diversity

1 材料与方法

1.1 试验材料

供试材料为一年生冬季休眠的富士/SH40/八棱海棠。

1.2 试验方法

1.2.1 根系分类 依据苗木根系状态将苗木根系分为3类,以期明确根系对树体失水的影响。一类根系:>2 mm的侧根条数大于20;二类根系:>2 mm的侧根条数8~20;三类根系:>2 mm的侧根条数小于8,如图1所示。



图1 不同根系类别

Fig.1 The different root category

1.2.2 缠膜处理 用0.2 mm厚度的白色地膜包裹幼树(根部包裹方式为直接用薄膜全部包裹,中间砧及接穗包裹方式为用薄膜缠住),随后用绳子捆绑以防薄膜脱落,定时称重。以单位时间内幼树散失的水分重量占鲜重的百分比作为失水率。

1.2.3 依据缠膜部位分为以下几种处理 根缠膜:1)根、中间砧和接穗缠膜;2)根和中间砧缠膜;3)根和接穗缠膜;根裸露;4)中间砧缠膜;5)中间砧和接穗缠膜(一类根系);6)中间砧和接穗缠膜(二类根系);7)中间砧和接穗缠膜(三类根系)。

表1 SH40 中间砧苗木各部位茎段表皮皮孔密度、皮孔面积和蒸腾强度比较

Table 1 The compare about the stem segment epidermis lenticel density, lenticel area and transpiration intensity from each part of the interstocks seedling

测定指标 The indicators of measurement	接穗茎段 Scion stem segment	中间砧茎段 Interstocks stem segment	基础茎段 Base stock stem segment
单位表皮皮孔密度 The units density of epidermis lenticel/(个·cm ⁻²)	14.67aA	7.53cC	8.45bB
单位表皮皮孔面积 The units area of epidermis lenticel/(mm ² ·cm ⁻²)	15.34aA	8.37cC	14.89bB
表皮蒸腾强 The transpiration intensity of epidermis/(H ₂ O g·g ⁻¹ ·h ⁻¹ FW)	0.001 5bB	0.001 2cB	0.003 4aA

注:方差分析采用 Duncan(D)法进行差异显著性分析,大、小写字母分别表示不同处理差异达 $P<0.01$ 和 $P<0.05$ 显著水平。

Note: The analysis of variance use Duncan (D) difference analysis method as significance level analysis, different capital and lowercase letters respectively mean significant difference at $P<0.01$ and $P<0.05$ levels.

同时中间砧茎段与接穗和基础茎段的持水力差异不显著(图2)。因此,中间砧茎段不是造成幼树休眠假植期间中间砧率先失水的主要部位,与SH40品种特性无关。

2.2 不同根系类别对SH40中间砧苗木中间砧茎段水分移动的影响

于苗木中间砧段处打孔,不同根系类别苗木红墨水

1.3 项目测定

茎段持水力测定参照马宝焜等^[10]的方法。表皮蒸腾强度的测定采用离体快速称重法^[11]。截取15 cm长的枝条,两端封蜡,随即用1/10 000天平称初重,2 h后称末重,3次重复,测定时间为每天的14:00。蒸腾速率($\text{H}_2\text{O g} \cdot \text{g}^{-1} \cdot \text{h}^{-1}$, FW)=(初重-末重)/(初重·2h)。茎段表皮皮孔面积测定参照于秋香等^[12]的方法。茎段表皮皮孔密度测定参照杨敏生^[13]的方法。SH40中间砧苗木失水率的测定:苗木洗净擦干,于室内通风处晾晒(室内平均室温22.5℃,相对湿度41.5%),定时称重,记录并绘制失水率曲线。茎段木质部水分移动距离测定:苗木洗净擦干,室内通风处水平放置,于幼树中间砧处用剪枝剪钻出一个小孔,深达木质部,打孔处放一块浸满红墨水(红墨水:水=1:17)的脱脂棉,5 min后用游标卡尺测定木质部中红墨水由起点至终点的移动距离。接穗与中间砧复水速率比较:截取15 cm长的中间砧及接穗枝条,两端封蜡,于室内自然通风处放置,定时称重。达到失水指标时,去蜡插入水中,初期每隔15 min称重,后期每隔1~2 h称重(称重时擦干枝条下端)。记录并绘制复水速率曲线。

1.4 数据分析

采用SPSS 17.0软件对数据进行统计分析。

2 结果与分析

2.1 SH40中间砧苗木各部位茎段表皮皮孔密度、皮孔面积、蒸腾强度和持水力的比较

由表1可以看出,SH40中间砧茎段的单位表皮皮孔密度、单位表皮皮孔面积均极显著小于接穗茎段及基础茎段;表皮蒸腾强度极显著小于基础茎段的表皮蒸腾强度,显著小于接穗茎段的表皮蒸腾强度。这表明通过SH40中间砧段表皮散失的水分并不是中间砧段率先失水的主要原因。

向根移动距离显著大于向接穗移动距离,且一类根系的苗木红墨水向根部的移动距离显著大于二类、三类根系苗木红墨水向根部的移动距离(图3)。由此可知,休眠期间SH40中间砧段水分可向接穗及根部双向移动,且在根系裸露时向根系移动距离远大于向接穗移动,且根系越庞大水分移动距离越大。

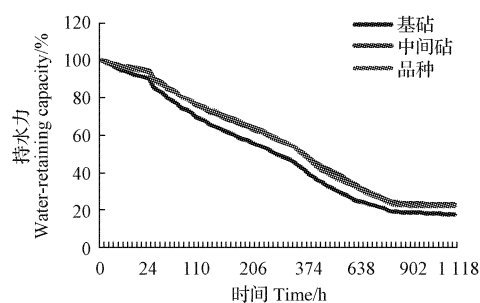


图2 幼树不同部位持水力比较

Fig. 2 The compare of water-retaining capacity of different parts of sapling

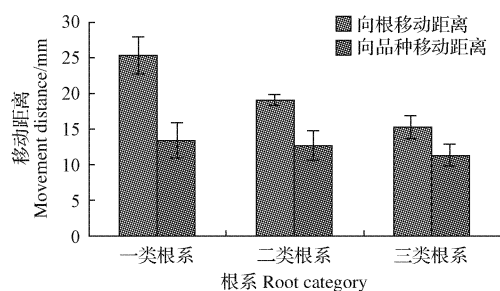


图3 不同根系类别对 SH40 中间砧苗木
中间砧茎段水分移动的影响

Fig. 3 The influence of different root category about moisture movement in SH40 interstocks seedling interstocks stem segment

2.3 不同根系类型苗木失水速率及缠膜处理对树体的影响

由图4可以看出,一类根系的苗木失水速率要显著高于二类及三类根系的失水速率。失水率达到20%,一类根系幼树所需时间为3 d,二类根系幼树所需时间为4 d,三类根系所需时间为6 d。因此,苗木根系越庞大,越旺盛,幼树失水速率越快。

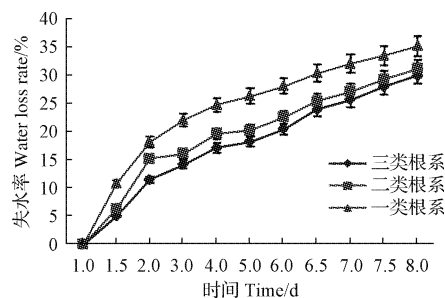


图4 不同根系类别失水速率比较

Fig. 4 The compare of water loss rate about different root category

同时,根系裸露的幼树失水速率显著大于根系包裹的幼树失水速率,且根系越庞大,侧根越多,相同时间内失水量越大,相对应的中间砧及接穗失水褶皱情况越严重(图5~7)。

2.4 不同失水程度对树体复水的影响

当接穗失水程度小于15%时,复水速率很快;超过

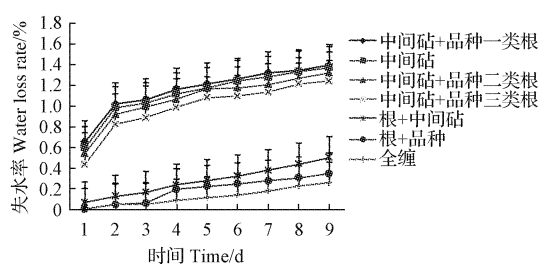
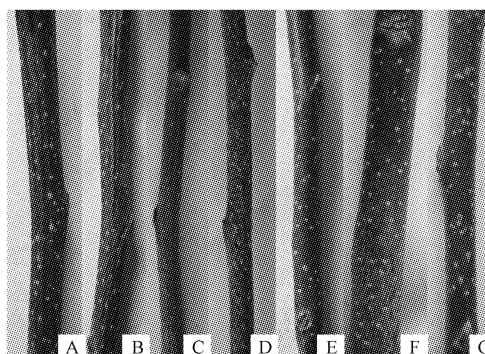


图5 幼树不同缠膜位置失水速率比较

Fig. 5 The compare of water loss rate about different wrap film processing of sapling



注:A~D根部裸露,A.中间砧和接穗缠膜,一类根系幼树;B.中间砧缠膜,C.中间砧和接穗缠膜,二类根系幼树;D.中间砧和接穗缠膜,三类根系幼树;E~G根部包裹,E.根和中间砧缠膜;F.根和接穗缠膜;G.幼树全部缠膜。图7同。

Note: A-D root bare, A. the wrap film of interstocks and scion, the first type of roots system; B. the wrap film of interstocks; C. the wrap film of interstocks and scion, the second types of roots system; D. the wrap film of interstocks and scion, the third types of root system; E-G root package, E. the wrap film of root and interstocks; F. the wrap film of root and scion; G. wrap film the all sapling. The same as Fig. 7.

图6 不同缠膜处理的幼树接穗失水状态对比

Fig. 6 The contrast of water loss about different wrap film processing of sapling scion

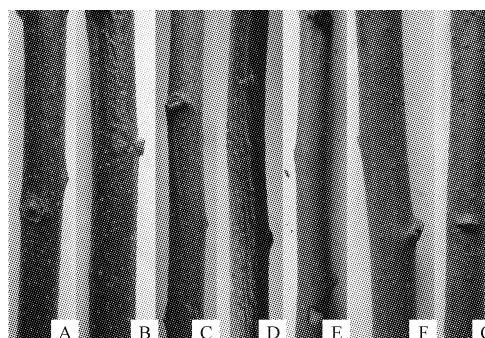


图7 不同缠膜处理的幼树中间砧失水状态对比

Fig. 7 The contrast of water loss about different wrap film processing of sapling interstocks

15%时,复水速率大大降低。中间砧失水10%后,复水速率相对于其它失水程度较快;且中间砧的复水速率要远远小于接穗的复水速率。失水率达到20%时,接穗及

中间砧的复水速率均变得缓慢;失水率超过 20% 复水能力大大降低,继续失水,枝条即失去复水能力或即使能复水枝条也不能恢复至初始状态。因此,失水达到鲜重的 20% 是中间砧及接穗能够复水成活的结点;当失水率达到 15% 时,中间砧及接穗均可复水成活;超过 20%,中间砧及接穗即失去复水能力(图 8~13)。

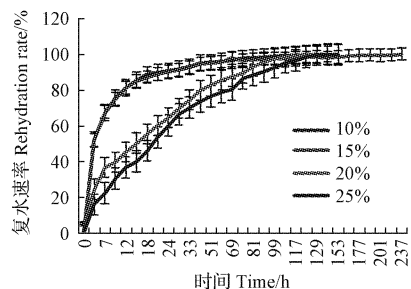


图 8 不同失水程度接穗的复水速率比较

Fig. 8 The compare of rehydration rate about the scion which loss water in different degree

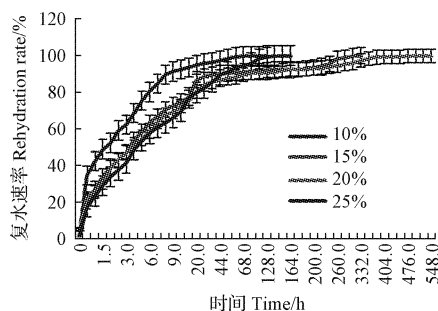
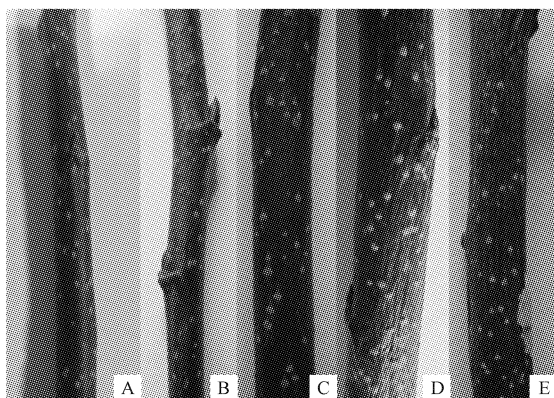


图 9 不同失水程度中间砧复水速率比较

Fig. 9 The compare of rehydration rate about the interstocks which loss water in different degree



注:失水程度,A. 未失水,B. 10%,C. 15%,D. 20%,E. 25%。图 11~13 同。

Note: The degree of water loss, A. no water loss, B. 10%, C. 15%, D. 20%, E. 25%. The same as Fig. 11—13.

图 10 接穗不同失水程度复水前状态

Fig. 10 The status of the scion which loss water in different degree before rehydration

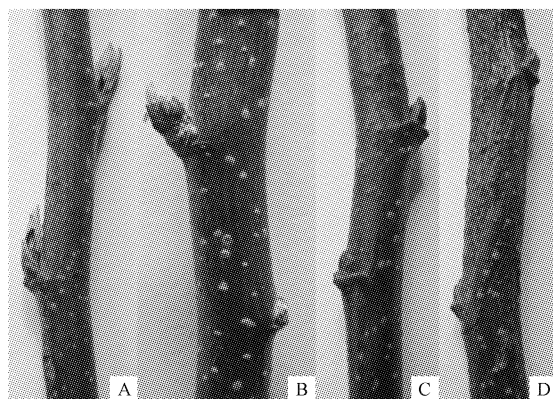


图 11 接穗不同失水程度复水后状态

Fig. 11 The status of the scion which loss water in different degree after rehydration

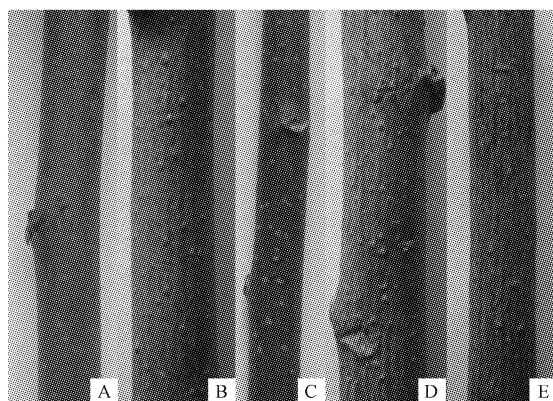


图 12 中间砧不同失水程度复水前状态

Fig. 12 The status of the interstocks which loss water in different degree before rehydration

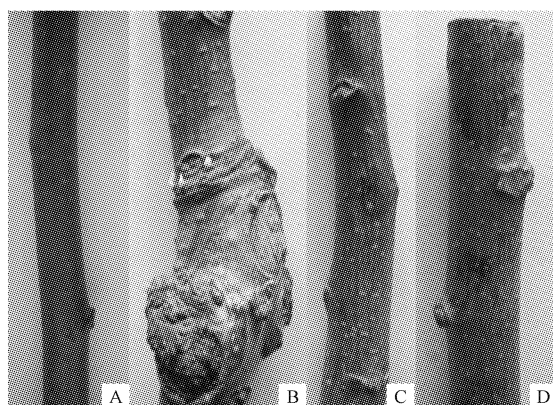


图 13 中间砧不同失水程度复水后状态

Fig. 13 The status of the interstocks which loss water in different degree after rehydration

3 讨论

持水力反映的是植物保持水分或延缓水分丧失的能力^[14-15],该研究表明 SH40 中间砧苗木中间砧段的持

水力与接穗及基础茎段的持水力无显著性差异,且中间砧茎段的单位表皮皮孔密度、单位表皮皮孔面积、表皮蒸腾强度均显著的小于接穗茎段及基础茎段,因此,SH40 中间砧苹果苗木中间砧段率先失水与中间砧茎段自身品种特性关系不大。

研究表明,幼树根系裸露情况下 SH40 中间砧段水分向根系移动距离远大于向接穗移动距离,且根系越大,失水速率越快,水分向根系移动距离越大,失水褶皱情况越严重。而薄膜包裹根系能显著地降低幼树的失水速率,降低中间砧段水分向根系的移动,显著改善中间砧段的失水褶皱情况,因此根系失水是 SH40 中间砧苗木越冬期假植中间砧段率先失水的主要原因。这可能是由于根系水分蒸腾量远大于接穗和中间砧,造成木质部导管内部形成水势差,导致距离根系较近的中间砧段中的水分向根部运移,以保证根系的水分供应,且由于接口的水分输导阻滞使得根系带走中间砧水分后而接穗水分并未及时运至中间砧而造成中间砧首先失水。

生产中,SH40 中间砧苹果苗木应重点对根系做好保护措施,可进行根部沾泥浆或者用接近泥浆的土覆盖根系,保证根系与土壤接触紧实,防止失水。

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Reason Analysis and Protective Measures of Temporary Planting SH40 Interstock Apple Seedling Water Loss During the Period of Dormancy

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Abstract: Currently,SH40 is the major application of apple dwarfing rootstocks in North China. During the production,SH40 interstocks segment apple seedling temporary planted would have the phenomena that loss water and occurs wrinkles at interstocks segment first and then even expand to the whole plant after the spring thaw soil,which is prejudicial to the production extremely. In this study,annual winter hibernation Fuji/SH40/Robusta was used as material and the reasons that the temporary planting SH40 interstocks apple seedling loss water in interstocks first during dormancy were studied. The results showed that,the reason that temporary planting SH40 interstocks seedling loss water at interstocks first during the dormancy period had not much relations to its varietal characteristics;the transpiration of roots system was a major reason that cause the interstocks segment loss water and occurs wrinkles first,and when the root lack water as well as the transpiration was large,there was a water potential difference in the conduit,which forced the migration in interstocks move to the roots reversely. Meanwhile,the larger root system was,the faster water loss rate was and the dehydration wrinkle was much more serious as well;the threshold that the interstocks and scion could rehydration successful was 20% of water loss rate,and the seedling cannot survive beyond the threshold.

Keywords: SH40 interstocks;apple seedling;dormant temporary planting;dehydration